

PATENT

DK-US055008

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE



In re Application of

Takeshi HIKAWA et al.

Serial No.: 10/521,942

Filed: January 21, 2005

For: DRIVE UNIT FOR COMPRESSOR  
AND REFRIGERATOR

Attn.: Application Processing Division  
Customer Correction Branch

**REQUEST FOR CORRECTION OF  
OFFICIAL FILING RECEIPT**

Assistant Commissioner of Patents  
Washington, DC 20231

Sir:

Applicants have noticed a U.S. Patent and Trademark Office error in the Title on the  
Official Filing Receipt. Specifically, the Title was incorrectly typed as

" DRIVER OF COMPRESSOR AND REFRIGERATOR "  
while it should be

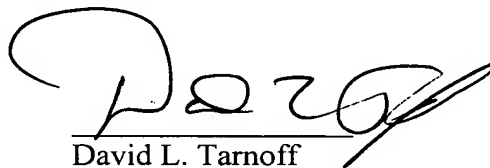
-- DRIVE UNIT FOR COMPRESSOR AND REFGIGERATOR --.

A Preliminary Amendment was filed with the application correcting the Title.

Attached is a copy of the Official Filing Receipt received from the PTO in the above application, with the correction noted thereon. Issuance of a corrected Filing Receipt is respectfully requested.

The correction is not due to Applicant error, therefore, no fee is due.

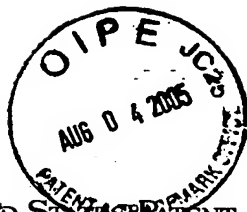
Respectfully submitted,

A handwritten signature in black ink, appearing to read 'D. Tarnoff', written over a horizontal line.

David L. Tarnoff  
Reg. No. 32,383

SHINJYU GLOBAL IP COUNSELORS, LLP  
1233 Twentieth Street, NW, Suite 700  
Washington, DC 20036  
(202)-293-0444  
Dated: 8-4-05

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## UNITED STATES PATENT AND TRADEMARK OFFICE

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APPL NO.	FILING OR 371 (c) DATE	ART UNIT	FIL FEE REC'D	ATTY. DOCKET NO	DRAWINGS	TOT CLMS	IND CLMS
10/521,942	01/21/2005	3744	1800	DK-US055008	12	38	2

CONFIRMATION NO. 3925

22919  
SHINJYU GLOBAL IP COUNSELORS, LLP  
1233 20TH STREET, NW, SUITE 700  
WASHINGTON, DC 20036-2680

## FILING RECEIPT



\*OC000000016508824\*

Date Mailed: 07/20/2005

Receipt is acknowledged of this regular Patent Application. It will be considered in its order and you will be notified as to the results of the examination. Be sure to provide the U.S. APPLICATION NUMBER, FILING DATE, NAME OF APPLICANT, and TITLE OF INVENTION when inquiring about this application. Fees transmitted by check or draft are subject to collection. Please verify the accuracy of the data presented on this receipt. If an error is noted on this Filing Receipt, please mail to the Commissioner for Patents P.O. Box 1450 Alexandria Va 22313-1450. Please provide a copy of this Filing Receipt with the changes noted thereon. If you received a "Notice to File Missing Parts" for this application, please submit any corrections to this Filing Receipt with your reply to the Notice. When the USPTO processes the reply to the Notice, the USPTO will generate another Filing Receipt incorporating the requested corrections (if appropriate).

## Applicant(s)

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## Assignment For Published Patent Application

DAIKIN INDUSTRIES, LTD., OSAKA, JAPAN

Power of Attorney: The patent practitioners associated with Customer Number 22919.

## Domestic Priority data as claimed by applicant

This application is a 371 of PCT/JP03/09415 07/24/2003

## Foreign Applications

Projected Publication Date: 10/20/2005

Non-Publication Request: No

Early Publication Request: No

RECEIVED

JUL 25 2005



Global IP Counselors, LLP

Title DRIVE UNIT for COMPRESSOR and REFRIGERATOR  
Driver of compressor and refrigerator

Preliminary Class

062

## PROTECTING YOUR INVENTION OUTSIDE THE UNITED STATES

Since the rights granted by a U.S. patent extend only throughout the territory of the United States and have no effect in a foreign country, an inventor who wishes patent protection in another country must apply for a patent in a specific country or in regional patent offices. Applicants may wish to consider the filing of an international application under the Patent Cooperation Treaty (PCT). An international (PCT) application generally has the same effect as a regular national patent application in each PCT-member country. The PCT process **simplifies** the filing of patent applications on the same invention in member countries, but **does not result** in a grant of "an international patent" and does not eliminate the need of applicants to file additional documents and fees in countries where patent protection is desired.

Almost every country has its own patent law, and a person desiring a patent in a particular country must make an application for patent in that country in accordance with its particular laws. Since the laws of many countries differ in various respects from the patent law of the United States, applicants are advised to seek guidance from specific foreign countries to ensure that patent rights are not lost prematurely.

Applicants also are advised that in the case of inventions made in the United States, the Director of the USPTO must issue a license before applicants can apply for a patent in a foreign country. The filing of a U.S. patent application serves as a request for a foreign filing license. The application's filing receipt contains further information and guidance as to the status of applicant's license for foreign filing.

Applicants may wish to consult the USPTO booklet, "General Information Concerning Patents" (specifically, the section entitled "Treaties and Foreign Patents") for more information on timeframes and deadlines for filing foreign patent applications. The guide is available either by contacting the USPTO Contact Center at 800-786-9199, or it can be viewed on the USPTO website at <http://www.uspto.gov/web/offices/pac/doc/general/index.html>.

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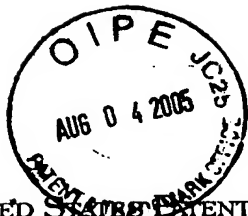
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## UNITED STATES PATENT AND TRADEMARK OFFICE

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U.S. APPLICATION NUMBER NO.	FIRST NAMED APPLICANT	ATTY. DOCKET NO.
10/521,942	Takeshi Hikawa	DK-US055008

INTERNATIONAL APPLICATION NO.
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PCT/JP03/09415

I.A. FILING DATE	PRIORITY DATE
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07/24/2003

22919  
SHINJYU GLOBAL IP COUNSELORS, LLP  
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WASHINGTON, DC 20036-2680

CONFIRMATION NO. 3925  
371 ACCEPTANCE LETTER



\*OC000000016508825\*

Date Mailed: 07/20/2005

**NOTICE OF ACCEPTANCE OF APPLICATION UNDER 35 U.S.C 371 AND 37 CFR 1.495**

The applicant is hereby advised that the United States Patent and Trademark Office in its capacity as a Designated / Elected Office (37 CFR 1.495), has determined that the above identified international application has met the requirements of 35 U.S.C. 371, and is ACCEPTED for national patentability examination in the United States Patent and Trademark Office.

The United States Application Number assigned to the application is shown above and the relevant dates are:

<u>01/21/2005</u>	<u>01/21/2005</u>
DATE OF RECEIPT OF 35 U.S.C. 371(c)(1), (c)(2) and (c)(4) REQUIREMENTS	DATE OF COMPLETION OF ALL 35 U.S.C. 371 REQUIREMENTS

A Filing Receipt (PTO-103X) will be issued for the present application in due course. **THE DATE APPEARING ON THE FILING RECEIPT AS THE " FILING DATE" IS THE DATE ON WHICH THE LAST OF THE 35 U.S.C. 371 (c)(1), (c)(2) and (c)(4) REQUIREMENTS HAS BEEN RECEIVED IN THE OFFICE. THIS DATE IS SHOWN ABOVE.** The filing date of the above identified application is the international filing date of the international application (Article 11(3) and 35 U.S.C. 363). Once the Filing Receipt has been received, send all correspondence to the Group Art Unit designated thereon.

The following items have been received:

- Copy of the International Application filed on 01/21/2005
- English Translation of the IA filed on 01/21/2005
- Copy of the International Search Report filed on 01/21/2005
- Preliminary Amendments filed on 01/21/2005
- Information Disclosure Statements filed on 01/21/2005
- Oath or Declaration filed on 01/21/2005
- Request for Immediate Examination filed on 01/21/2005
- U.S. Basic National Fees filed on 01/21/2005
- Assignment filed on 01/21/2005
- Priority Documents filed on 01/21/2005
- Power of Attorney filed on 01/21/2005

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Applicant is reminded that any communications to the United States Patent and Trademark Office must be mailed to the address given in the heading and include the U.S. application no. shown above (37 CFR 1.5)

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DARRELL C COTTMAN

Telephone: (703) 308-9140 EXT 203

PART 1 - ATTORNEY/APPLICANT COPY

FORM PCT/DO/EO/903 (371 Acceptance Notice)

DK-US055008

## IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Application of :  
Takeshi HIKAWA et al. :  
Serial No.: New – (National Phase of :  
PCT/JP2003/009415) :  
Filed: Herewith :  
For: DRIVE UNIT FOR COMPRESSOR AND :  
REFRIGERATOR (AS AMENDED) :

**PRELIMINARY AMENDMENT**

Assistant Commissioner of Patents  
Washington, DC 20231

Sir:

Prior to examination of the above-identified application, please amend the subject application as follows.

**Amendments to the Title** begin on page 2 of this paper.

**Amendments to the Specification** begin on page 3 of this paper.

**Amendments to the Abstract** begin on page 4 of this paper.

**Amendments to the Claims** are reflected in the Listing of Claims, which begins on page 5 of this paper. Claims 1-58 are pending, with claims 1 and 6 being the only independent claims.

**Remarks/Arguments** begin on page 13 of this paper.



Serial No.: New – PCT/ JP2003/009415 Nat'l Phase  
Filed: Herewith

**AMENDMENTS TO THE TITLE:**

Please replace the title of this application with the following rewritten version:

**DRIVE UNIT FOR ~~DRIVER OF~~ COMPRESSOR AND REFRIGERATOR**

**AMENDMENTS TO THE SPECIFICATION:**

Please add the following paragraph on page 1, between lines 2 and 3:

**CROSS-REFERENCE TO RELATED APPLICATIONS**

-- This nonprovisional application claims priority under 35 U.S.C. §119(a) to Japanese Patent Application No. 2002-216025, filed in Japan on July 25, 2002, and Japanese Patent Application No. 2002-367841, filed in Japan on December 19, 2002, the entire contents of which are hereby incorporated by reference. --

Please replace the heading at page 2, line 26, with the following rewritten version:

**SUMMARY OF THE INVENTION ~~DISCLOSURE OF THE INVENTION~~**

Please replace the heading at page 24, line 3, with the following rewritten version:

**DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS ~~BEST~~  
~~MODE FOR CARRYING OUT THE INVENTION~~**

Please replace the heading at page 50, line 1, with the following rewritten version:

**WHAT IS CLAIMED IS: ~~CLAIMS~~**

**AMENDMENTS TO THE ABSTRACT:**

Please replace the paragraph (Abstract) beginning at page 58, line 1 with the following rewritten version:

**ABSTRACT**

An instantaneous current and instantaneous voltage of a three-phase coil (~~10~~) of a brushless DC motor (~~6~~) are detected, and the internal condition of a compressor (~~1~~) is predicted from these detection values. The prediction about the internal condition of the compressor (~~1~~) is made in such a way that motor driving torque which is a parameter of a motor model is identified and poor lubrication, liquid compression or the like is predicted from this identified motor driving torque. This enables it to make, in real time, a failure forecast, failure diagnosis etc. on the compressor (~~1~~).

The following Listing of Claims will replace all prior versions, and listings, of claims in the application.

**LISTING OF CLAIMS:**

1. (Currently Amended) A drive unit for a compressor having a motor (6), the drive unit comprising:

a detecting component configured and arranged to detect at least one of means (16, 17) for detecting the a current of said motor and/or a voltage of said motor (6); and

a prediction component configured and arranged to predict means (28) for predicting an internal condition based on detection values obtained by said detecting means (16, 17) component.

2. (Currently Amended) The drive unit ~~for a compressor~~ according to claim 1, wherein

the prediction component means (28) has an identification component means (20) for identifying a parameter of a motor model from the detection values obtained by the detecting component means (16, 17), and a derivation component means (21) for deriving the internal condition based on the parameter identified by said identification component means (20).

3. (Currently Amended) The drive unit ~~for a compressor~~ according to claim 1, wherein

the internal condition predicted by the prediction component means (28) is shaft abnormalities or poor lubrication.

4. (Currently Amended) The drive unit ~~for a compressor~~ according to claim 1, wherein

the internal condition predicted by the prediction component means (28) is motor temperature.

5. (Currently Amended) The drive unit ~~for a compressor~~ according to claim 1, wherein the motor ~~(6)~~ is a brushless DC motor.

6. (Currently Amended) A refrigerator comprising: having a refrigerant circuit provided with a compressor ~~(1)~~ including a motor; ~~(6), the refrigerator comprising:~~  
a detecting component configured and arranged to detect at least one of means (16, 17) for detecting the a current of said motor and/or a voltage of said motor (6); and  
a prediction component configured and arranged to predict means (28) for predicting an internal condition of the compressor ~~(1)~~ based on detection values obtained by said detecting ~~means (16, 17) component~~.

7. (Currently Amended) The refrigerator according to claim 6, wherein said prediction component means (28) has an identification component means (20) for identifying a parameter of a motor model from the detection values obtained by the detecting component means (16, 17), and a derivation component means (21) for deriving the internal condition of the compressor ~~(1)~~ based on the parameter identified by the identification component means (20).

8. (Currently Amended) The refrigerator according to claim 6, wherein said motor ~~(6)~~ is a brushless DC motor.

9. (Currently Amended) The refrigerator according to claim 7, wherein the parameter identified by said identification component means (20) is motor driving torque.

10. (Currently Amended) The refrigerator according to claim 6, wherein the internal condition predicted by said prediction component means (28) is the high refrigerant pressure or low refrigerant pressure of the refrigerant circuit.

11. (Currently Amended) The refrigerator according to claim 9, wherein said refrigerant circuit is provided with a refrigerant detecting means ~~(22, 23)~~ for detecting a refrigerant state, and

~~wherein~~ said derivation component means (21) ~~derives~~ being configured to derive the high refrigerant pressure or low refrigerant pressure of the refrigerant circuit based on the motor driving torque identified by the identification component means (20) and the refrigerant state detected by the refrigerant detecting component means (22, 23).

12. (Currently Amended) The refrigerator according to claim 9, wherein said refrigerant circuit is provided with ~~the~~ a refrigerant detecting component means (22, 23) for detecting a refrigerant state, and

~~wherein~~ the derivation means ~~(21)~~ is formed such that the relationship between motor driving torque corresponding to the at least one of a refrigerant temperature and/or a refrigerant pressure of the refrigerant circuit and the degree of suction superheat of the compressor ~~(1)~~ is set beforehand and such that the degree of suction superheat of the compressor ~~(1)~~ is derived based on the motor driving torque identified by the identification means ~~(20)~~ and the refrigerant state detected by the refrigerant detecting component means (22, 23).

13. (Currently Amended) The refrigerator according to claim 6, wherein the internal condition predicted by the prediction component means (28) is occurrence of an impact load within the compressor ~~(1)~~.

14. (Currently Amended) The refrigerator according to claim 13, wherein the detection value obtained by the detecting component means (16) is the current of the motor ~~(6)~~, and

~~wherein~~ the prediction component means (28) predicts occurrence of an impact load from the higher harmonic component of the detection current obtained by the detecting component means (16).

15. (Currently Amended) The refrigerator according to claim 14, wherein the prediction component means (28) predicts occurrence of an impact load from the amount of distortion in the sine wave of the higher harmonic component of the detection current.

16. (Currently Amended) The refrigerator according to claim 14, wherein the prediction component means (28) predicts occurrence of an impact load when the higher harmonic component of the detection current is greater than a preset reference value.

17. (Currently Amended) The refrigerator according to claim 16, wherein the reference value for the prediction component means (28) is set in accordance with at least one of the refrigerant temperature and/or refrigerant pressure of the refrigerant circuit.

18. (Currently Amended) The refrigerator according to claim 6, wherein the internal condition predicted by the prediction component means (28) is poor lubrication or liquid compression in the compressor (4).

19. (Currently Amended) The refrigerator according to claim 18, wherein the detection value obtained by the detecting component means (16) is the current of the motor (6), and

~~wherein~~ the prediction component means (28) predicts the poor lubrication or liquid compression of the compressor (4), based on the increasing rate of the detection current obtained by the detecting component means (16).

20. (Currently Amended) The refrigerator according to claim 19, wherein the refrigerant circuit is equipped with a refrigerant detecting component means (22, 23) for detecting a refrigerant state, and

~~wherein~~ the prediction component means (28) is formed such that a stationary current for the motor (6) in its steady state is set based on the detection current detected by the

detecting component means (16) and based on the refrigerant state detected by the refrigerant detecting component means (22, 23) and such that the poor lubrication or liquid compression of the compressor (1) is predicted by making a comparison between said stationary current and the detection current detected by the detecting component means (16).

21. (Currently Amended) The refrigerator according to claim 9, wherein the prediction component means (28) predicts poor lubrication or liquid compression in the compressor (1) based on an increase in motor driving torque which exceeds a specified value.

22. (Currently Amended) The refrigerator according to claim 21, wherein the refrigerant circuit is equipped with a refrigerant detecting component means (22, 23) for detecting a refrigerant state, and

wherein the prediction component means (28) is formed such that a stationary torque for the motor (6) in its steady state is set based on the motor driving torque identified by the identification component means (20) and based on the refrigerant state detected by the refrigerant detecting component means (22, 23) and such that the poor lubrication or liquid compression of the compressor (1) is predicted by making a comparison between said stationary torque and the motor driving torque identified by the identification component means (20).

23. (Currently Amended) The refrigerator according to claim 9, wherein the prediction component means (28) outputs information on the internal condition of the compressor (1) which has been predicted.

24. (Currently Amended) The refrigerator according to claim 9, further comprising:

a protection means (29) for configured and arranged to protecting the compressor (1) based on information on the internal condition of the compressor (1) predicted by the prediction component means (28).



25. (Currently Amended) The refrigerator according to claim 24, wherein the protection component means (29) controls an inverter controlling component means (26) for driving the compressor (1) to perform a protective operation of the compressor (1).

26. (Currently Amended) The refrigerator according to claim 25, wherein the protection component means (29) controls the inverter controlling component means (26) to perform the protective operation of the compressor (1) in preference to operation control of the refrigerant circuit.

27. (Currently Amended) The refrigerator according to claim 24, further comprising:

a switching component means for switching from the protective operation of the protection component means (29) to a steady operation, based on the information on the internal condition of the compressor (1) which has been predicted by the prediction component means (28).

28. (Currently Amended) The refrigerator according to claim 24, wherein the protection component means (29) makes a failure diagnosis on the compressor 1.

29. (Currently Amended) The refrigerator according to claim 28, further comprising:

a memory component means (24) for memorizing the result of the diagnosis made by the protection component means (29).

30. (Currently Amended) The refrigerator according to claim 24, wherein the protection component means (29) is so formed as to forecast a failure in the compressor (1).

31. (Currently Amended) The refrigerator according to claim 30, further comprising:

a communication component means (31) for outputting information on the forecast made by the protection component means (29).

32. (Currently Amended) The refrigerator according to claim 24, wherein the protection component means (29) is so formed as to alter the control content or control parameter of the refrigerant circuit.

33. (Currently Amended) The refrigerator according to claim 6, wherein a refrigerant system model for the refrigerant circuit is provided beforehand, and the operating condition of the refrigerant circuit is predicted based on information on the internal condition of the compressor (4) predicted by the prediction component means (28).

34. (Currently Amended) The refrigerator according to claim 7, wherein the motor (6) is a brushless DC motor, and  
~~wherein~~ the prediction component means (28) predicts a motor temperature from the current and voltage of the motor (6) and instrument constants.

35. (Currently Amended) The refrigerator according to claim 7, wherein the motor (6) is a brushless DC motor,  
~~wherein~~ the identification means (20) identifies a parameter based on a motor model constituted by the current and voltage of the motor (6), resistance and inductance, and  
~~wherein~~ the derivation component means (21) derives motor temperature based on the parameter identified by the identification component means (20).

36. (Currently Amended) The refrigerator according to claim 35, wherein the identification component means (20) obtains a motor voltage equation in such a way that a d-axis is plotted in the direction of the N pole of magnets (1b) of the motor (6), a q-axis is plotted in the direction which is shifted forward from the d-axis by  $\pi/2$ , and a motor

basic voltage equation for a three-phase PMSM is converted into a d, q axis coordinate system which rotates at an electric angular speed  $\omega$ , and the identification component means (20) then identifies a magnetic flux characteristic value associated with an armature flux linkage generated by the magnets (1b), using said motor voltage equation, and

~~wherein~~ the derivation component means (21) derives the temperature of the magnets (1b) as motor temperature based on the magnetic flux characteristic value identified by the identification component means (20).

37. (Currently Amended) The refrigerator according to claim 36, wherein the identification component means (20) obtains a voltage equation for a steady state from the motor voltage equation, and at the time of the identification, the d-axis component of the armature current of said steady-state voltage equation is set to zero.

38. (Currently Amended) The refrigerator according to claim 35, wherein the refrigerant circuit has a refrigerant detecting component means (24) for detecting the temperature of a discharge pipe of the compressor (1), and

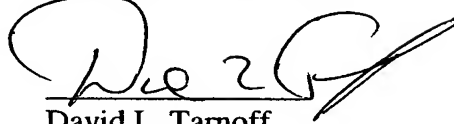
~~wherein~~ a calibration component means (36) is being configured such that the motor temperature derived by the derivation component means (21) being regarded as the internal temperature of the compressor 1, the internal temperature derived by the derivation component means (21) is calibrated based on the discharge pipe temperature detected by the temperature detecting component means (24).

Serial No.: New – PCT/ JP2003/009415 Nat'l Phase  
Filed: Herewith

**REMARKS**

Entrance of this Amendment is respectfully requested.

Respectfully submitted,

A handwritten signature in black ink, appearing to read 'D. L. Tarnoff', written over a horizontal line.

David L. Tarnoff  
Attorney of Record  
Reg. No. 32,383

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Dated: 01-21-05

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